AIL Systems, Inc.

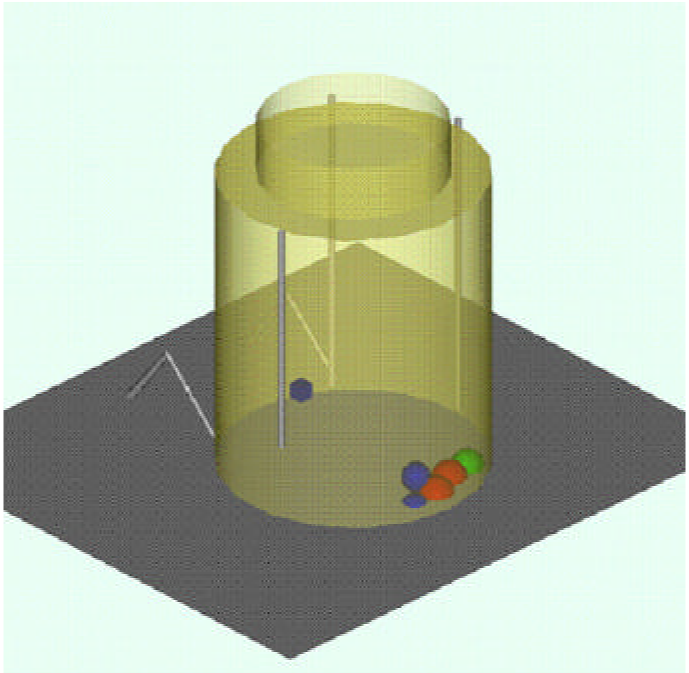
3-D Visual and Gamma Ray Imaging System

Technology Need:

Radiological characterization and monitoring are important components of environmental management activities throughout the Department of Energy (DOE) complex. The baseline technology is a standard manual survey performed by trained health physics technicians, or 2-D gamma imaging. Manual surveys are time consuming, tedious, and directly expose personnel to radiation. A technology is needed that can provide real-time characterization data without directly exposing personnel to radiation.

Technology Description:

AIL Systems, Inc. has developed a system which can remotely survey large areas and individual objects for gamma ray emissions and display the results as combined three-dimensional (3-D) representations of the radiation sources and the equipment. The technology, known as the *3-D Visual and Gamma Ray Imaging System*, consists of four modules: a sensor head, a portable PC compatible computer, a pan and tilt controller, and a 3-D workstation. The sensor head is controlled remotely by the PC and the pan and tilt controller. The laser range finder and the ability to resolve angles in multiple axes of motion provides information necessary to triangulate for determination of the actual point in space of the imaging target and the gamma detector. Remote operation and control allows for safe data acquisition in high radiation environments, minimizing operator exposure.



During image-taking operation, a pseudo-color image of gamma ray emitting sources is overlaid on the video picture of the scene. At each camera location with observed gamma ray emissions, additional images are taken of key reference features in the scene, along with the measured range and pan and tilt directions for these features. The later images are used to locate the relative camera positions.

The exposure time required to obtain a gamma image is dependent upon several factors, including gamma-ray energy, the distance to the source, and the shape and distribution of the source. From the two-dimensional (2-D) data, the dose estimates at the sensor head are calculated. After 3-D processing, the distance to the source obtained by triangulation is used to derive a dose for the source. The system can calculate a dose at any point in space with a default of a "30-cm" dose rate. The 3-D geometry increases the knowledge of the source location and resulting dose estimate. A table of source locations and "30-cm" dose estimates is generated for each contaminated object. These data are merged with a drawing generated in AutoCAD™ for a visual representation of the object. The resulting merged drawing gives source positions with respect to visually identified objects. The merged drawing can be manipulated to allow the representations to be viewed from different angles.

Benefits:

<Remote operation reduces worker exposure to radiation and eliminates the need for and control of extensive shielding

<Use of the system leads to reduced labor costs

<System provides more reliable data

<Operation of the system is relatively simple

<Provides operator with real-time display gamma ray images

<3-D images help to improve communications with regulators and stakeholders

<System can be used to identify source locations

Status and Accomplishments:

The 3-D Visual and Gamma Imaging System was demonstrated in August 1999 at Hanford's 221-U Facility for characterization of equipment within the processing cells of the facility. This information was gathered in support of the Canyon Disposition Initiative (CDI) Project. The technology was used to provide images and radiation measurements of equipment, tanks, etc., on the canyon deck and in other areas of the facility.

During this demonstration, the AIL system located contamination on the canyon deck in three dimensions and found small amounts of radioactivity in a piece of equipment located on the deck ranging from between 50 mr/hr to 80 mr/hr. The GAMMAMODELER™ system software was used to transform extended sources into a series of point sources, locate in three dimensions the positions of these sources, and calculate the dose rates for these sources.

The system performed well during the demonstration and obtained data on 21 objects of interest to the CDI Project. Real-time display of the gamma ray images to the operator showed that seven of these objects had detectable emissions. For these objects, additional views were obtained to allow 3-D rendering. The 3-D rendering showed the sources in relationship to the visual object.

Several of the 221-U Facility cells were imaged. Even with the limited viewing angles that could be obtained for these cases, the 3-D rendering software still allowed 3-D representations of the source locations and strengths to be determined. For cell 10, the system was able to determine the source distributions and intensities at distances greater than 12.2 m (40 ft). These sources are of high dose intensities and would not be accessible to radiological control technicians using hand-held instrumentation.

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Online Resources:

Office of Science and Technology, Technology Management System (TMS), Tech ID # 2402
http://ost.em.doe.gov/tms

The National Energy Technology Laboratory Internet address is **http://www.netl.doe.gov**

For more information on AIL Systems, Inc., please visit their Internet site at **http://www.ail.com/**

An Innovative Technology Summary Report (ITSR) for this innovative technology can be found at **http://apps.em.doe.gov/ost/pubs/itsrs/itsr2402.pdf**